

REMARKS

The specification has been amended for clarification purposes only, and does not present new matter. In addition, claims 1, 11, 12, 17, 18, 28, 29, 32, 34, and 36 have been amended, claim 16 has been canceled, and claim 37 has been added. As such, claims 1-15, 17, 18, and 28-37 are currently pending in the case. Further examination and reconsideration of the presently claimed application are respectfully requested.

Section 112 Rejection

Claim 1 was rejected under 35 U.S.C. § 112, second paragraph, for failing to particularly point out and distinctly claim the subject matter which the Applicant regards as the invention. More specifically, claim 1 was rejected for lacking sufficient antecedent basis for "the nitride layer." To expedite prosecution, claim 1 has been amended. This amendment is believed to clarify the claim language in a manner that addresses the concerns expressed in the Office Action about. Accordingly, removal of this rejection is respectfully requested.

Section 102 Rejections

Claims 1, 4-8, 11, 29, and 30 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,630,407 to Keil et al. (hereinafter "Keil"). A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. Of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987), MPEP 2131. Keil does not disclose all limitations of the currently pending claims, some distinctive limitations of which are set forth in more detail below.

Keil fails to disclose a method for etching a stack of layers, comprising an anti-reflective layer, a nitride layer and an underlying layer, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack. Amended claim 1 recites in part:

A method for processing a semiconductor topography, comprising: etching a stack of layers within a single etch chamber, wherein the stack of layers comprises: an anti-reflective layer; a nitride layer arranged beneath and in contact with the antireflective layer; an underlying layer arranged beneath the nitride layer; and wherein said etching a

stack of layers comprises etching one or more layers in the stack with a different etch chemistry than used for etching other layers in the stack ...

Amended claim 29 recites:

A method for processing a semiconductor topography, comprising etching a stack of layers in a single etch chamber with a sequence of different etch chemistries, wherein the step of etching the stack of layers comprises: etching an antireflective layer with a first etch chemistry comprising a noble gas heavier than helium; and etching a silicon nitride layer, which is arranged beneath and in contact with the antireflective layer, with a second etch chemistry different than the first etch chemistry.

Amended independent claim 11 recites a similar limitation. Support for the amendments made to claims 1, 11, and 29 may be found in the specification, for example, on page 11, line 26 to page 12, line 10.

Keil discloses "[a] semiconductor manufacturing process wherein an organic anti-reflective coating (ARC) is plasma etched with selectivity to an underlying dielectric layer and/or overlying photoresist. The etchant gas is fluorine-free and includes a carbon-containing gas such as CO gas, a nitrogen containing gas such as N₂, an optional oxygen containing gas such as O₂, and an optional inert carrier gas such as Ar." (Keil, Abstract). As described in more detail below, however, the manufacturing process of Keil does not include the presently claimed step of etching a stack of layers, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack.

In the Final Office Action, the Examiner admittedly states that "Keil is silent about the etching chemistry for the nitride layer [being] different than the etch chemistry for the ARC layer." (Final Office Action, page 3). The Examiner further admits that "Keil doesn't describe ... etching the underlying layer with an etch chemistry different [than] that of the first and second chemistries." (Final Office Action, page 4). As such, the Examiner acknowledges the lack of teaching within Keil for the presently claimed etch process, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack. However, the Examiner appears to suggest that the presently claimed etch process is inherently taught by Keil. For example, the Examiner suggests that "[s]ince the ARC etch chemistry is tailored so that it would etch the ARC selectively to the under layer including the nitride layer... the nitride must be etched by another different chemistry." (Office Action, page 3). The Applicant respectfully disagrees, for at least the reasons set forth below.

The primary objective of Keil is to overcome "a problem associated with etching an ARC layer with fluorine." (Keil, column 3, lines 55-56). For example, Keil discloses that the "use of fluorocarbon gases to generate a protective polymer on ... the etched openings of the ARC can cause profile and uniformity issues due to attack of the underlying layer by the fluorine atoms present in the plasma." (Keil, column 3, lines 56-61). To minimize the attack on underlying dielectric layers during the ARC etch, Keil uses a fluorine-free, carbon-containing etchant gas (preferably, carbon monoxide, CO), which is chosen for its high selectivity to materials used in dielectric layers (e.g., oxides). The high selectivity of the fluorine-free, carbon-containing etchant gas minimizes CD loss and improves the uniformity and profile of the etch by etching the underlying dielectric layer at a much slower rate than if fluorine-based etchant gases were used in the ARC etch. (See, e.g., Keil, column 4, lines 1-25). In one embodiment, Keil discloses the ARC etch chemistry as including a "carbon-containing gas such as CO gas, a nitrogen containing gas such as N₂, an optional oxygen containing gas such as O₂, and an optional inert carrier gas such as Ar." (Keil, Abstract).

The only etch chemistry disclosed by Keil is the etch chemistry mentioned above for use in the ARC etch or "pre-etch" process. Though Keil discloses that additional etching steps may follow the ARC etch (See, e.g., Keil, column 2, lines 44-45 and FIGS. 1-4, which show pre-etch and post-etch conditions), Keil does not disclose that a different etch chemistry may be used during the additional (i.e., post-etch) processes. Therefore, Keil fails to provide explicit teaching for the presently claimed etching process, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack.

In addition, there is no inherent teaching within Keil for using different etch chemistries in the pre-etch and post-etch processes. As noted above, the Examiner suggests that because the ARC etch chemistry is highly selective to layer(s) underlying the ARC layer, the post-etch chemistry must be changed in order to etch the underlying layers. This is not necessarily true. For example, the high selectivity of the ARC etch chemistry may be used to etch an underlying dielectric layer at a much slower rate than the rate at which the ARC layer is etched. This is one of the very reasons why Keil uses such an ARC etch chemistry. Merely stating that a particular etch chemistry is selective to an underlying layer does not provide sufficient motivation, or inherent teaching, for the underlying layer being subsequently etched with a different etch chemistry. Keil simply fails to provide motivation for changing the etch chemistry in post-etch processes, and therefore, provides no inherent teaching or suggestion for the presently claimed etching process.

As noted above, a claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. *Verdegaal Bros. v. Union Oil Co. Of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987), MPEP 2131. Since Keil fails to expressly or inherently describe all elements of the presently claimed etching process, Keil cannot be relied upon to anticipate present claims 1, 11, and 29, as well as claims dependent therefrom. Accordingly, Applicants respectfully request removal of this rejection.

Section 103 Rejections

Claims 9, 10, 28, 32, and 35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Keil. Claims 2, 3, 12-17, 31, and 33 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Keil in view of U.S. Patent No. 5,626,775 to Roberts et al. (hereinafter "Roberts"). Claim 18 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Keil in view of U.S. Patent No. 6,117,786 to Khajehnouri et al. (hereinafter "Khajehnouri"). Claims 34 and 36 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Keil in view of U.S. Patent No. 6,403,484 to Lim et al. (hereinafter as "Lim"). As noted above, claim 16 has been canceled rendering rejection thereto moot.

To establish a *prima facie* obviousness of a claimed invention, all claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP 2143.03. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed.Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992); MPEP 2143.01. The cited art does not teach or suggest each and every limitation of the currently pending claims, some distinctive limitations of which are set forth in more detail below.

None of the cited art teaches or suggests a method for etching a stack of layers, comprising an anti-reflective layer, a nitride layer and an underlying layer, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack. This is the same limitation argued above in regard to the § 102(e) rejection of claims 1, 11, and 29. As noted above, Keil fails to provide teaching or suggestion for etching a stack of layers having an antireflective coating (ARC) layer, a nitride layer and an underlying layer, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack. Based on the teachings of Keil, there is no motivation for one skilled in the art to etch one or more layers in the stack with a different etch chemistry, since Keil only discloses the etch chemistry to be used in the ARC etch or

"pre-etch" process. Keil fails to disclose an etch chemistry that may be used during the "post-etch" process performed after the ARC etch, and as such, fails to provide teaching, suggestion or motivation for etching one or more layers (e.g., underlying the ARC layer) with a different etch chemistry than used for etching the ARC layer.

Furthermore, the teachings of Keil cannot be modified to include the presently claimed etch process, since Keil fails to even suggest a desirability for etching one or more layers in the stack with a different etch chemistry than used for etching the ARC layer. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination [or modification]. *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990); MPEP 2143.01.

Though not cited against claims 1, 11, and 29, the remaining cited art cannot be combined with Keil to overcome the deficiencies therein. More specifically, the teachings of Roberts, Khajehnouri and Lim cannot be used to overcome the lack of teaching and motivation within Keil for the presently claimed etch process, since Roberts, Khajehnouri and Lim each fail to provide teaching or suggestion for etching a stack of layers, comprising an anti-reflective layer, a nitride layer and an underlying layer, where one or more layers in the stack are etched with a different etch chemistry than used for etching other layers in the stack.

Even if one attempted to combine the teachings of the cited art, the combination would be improper, since Keil specifically teaches away from the combination. It is improper to combine references where the references teach away from their combination. *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). MPEP 2145 (X)(D)(2). A *prima facie* case of obviousness may be rebutted by showing that the art, in any material respect, teaches away from the claimed invention. *In re Geisler*, 116 F.3d 1465, 1471, 43 USPQ2d 1362, 1366 (Fed. Cir. 1997); MPEP 2144.05 (II).

As noted above, the primary objective of Keil is to overcome problems "associated with etching an ARC layer with fluorine ... by using a fluorine-free carbon-containing etching gas." (See, e.g., Keil, column 3, line 55 to column 4, line 25). As such, Keil specifically teaches away from fluorine-based etchant gases, such as those purposefully chosen by Roberts (See, Abstract) and Khajehnouri (See, Abstract). (Note: Lim fails to disclose a single etch chemistry, and therefore, provides no motivation for etching one or more layers with a different etch chemistry.) Since Keil teaches away from the fluorine-

based etchants used by Roberts and Khajehnouri, the combination of Keil with Roberts or Khajehnouri would simply be improper.

For at least the reasons stated above, none of the cited art teaches, suggests, or provides motivation for all limitations of claims 1, 11, and 29. Furthermore, the cited art cannot be combined or modified to do so. Therefore, claims 1, 11, and 29, as well as claims dependent therefrom, are asserted to be patentably distinct over the cited art. Claim 16 has been canceled rendering rejection thereto moot. Accordingly, Applicants respectfully request removal of this rejection.

Patentability of the Added Claims

The present amendment adds claim 37. Claim 37, which is dependent upon claim 11, is patentably distinct over the cited art for at least the same reasons as that claim. As will be set forth in more detail below, claim 37 is also patentably distinct over the cited art.

None of the cited art teaches or suggests etching a stack of layers, including an antireflective layer, a cap (e.g., nitride) layer and a lower layer, where a noble gas heavier than helium is introduced into the etching chamber during etching of each of the layers, and where at least one of the noble gases introduced during etching of one of the layers differs from the other noble gases introduced. Added claim 37 recites: "[t]he method of claim 17, wherein at least one of said first, second and third noble gases differs from the remaining noble gases." Support for the limitations of added claim 37 may be found in the Specification, for example, on page 13, line 7 to page 14, line 10.

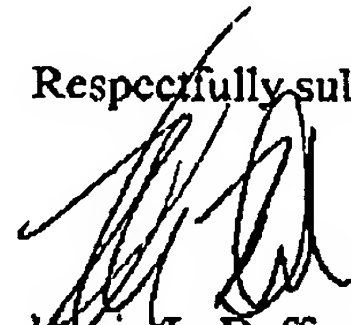
The only etch chemistry taught by Keil is the one used in the ARC etch. Though Keil mentions that argon (Ar) may be included in the etch chemistry "to help strike the plasma" during the ARC etch (Keil, column 4, lines 10-14), Keil does not teach or suggest that different noble gases may be introduced when etching other layers in the stack. Khajehnouri, Roberts and Lim each fail to discuss etching multiple layers with multiple etch chemistries, much less etching a stack of layers (including an antireflective layer, a cap layer and a lower layer) with multiple etch chemistries including one or more different noble gases. Consequently, Keil, Khajehnouri, Roberts and Lim, taken alone or in combination, fail to teach or suggest all limitations of added claim 37. Accordingly, allowance of claim 37 is respectfully requested.

CONCLUSION

This response constitutes a complete response to all issues raised in the final Office Action mailed July 23, 2004. In view of the remarks traversing the rejections, Applicants assert that pending claims 1-15, 17, 18, and 28-37 are in condition for allowance. If the Examiner has any questions, comments, or suggestions, the undersigned attorney earnestly requests a telephone conference.

No fees are required for filing this amendment; however, the Commissioner is authorized to charge any additional fees, which may be required, or credit any overpayment, to Conley Rose, P.C. Deposit Account No. 50-3268/5298-06900.

Respectfully submitted,



Kevin L. Daffer
Reg. No. 34,146
Attorney for Applicants

Conley Rose, P.C.
P.O. Box 684908
Austin, TX 78768-4908
Ph: (512) 476-1400
Date: September 16, 2004
JMF